PSYCHE.

NOTES ON SOME APHID STRUCTURES.

BY JOHN B. SMITH, NEW BRUNSWICK, N. J.

DURING the season of 1890, the most notable feature in New Jersey was the enormous increase in the numbers of the *aphididae*. Naturally, as complaints of injuries were received, I was compelled to pay some attention to these insects, and a Bulletin of the Station has been prepared treating of some of the more injurious forms. It is part of my creed, whenever I look at an insect, whatever its order, to see all I can, and so far as the characters are interesting, and bear at all on the philosophy of economic entomology (for I believe that economic entomology is simply the philosophic application of the facts ascertained by a technical study to the practical needs of Agriculture). I do not hesitate in presenting them in a popular way in the Bulletins of the Station. Sometimes the facts observed have, or may have a technical bearing, and as the Station Bulletins under present circumstances are hardly ranked as technical publications I prefer to present them in another form in the technical journals also.

The principal points studied were the beak and antennae. So far as the latter organs are concerned there is room for a great deal of histological work, and much more use than has been made, in systematic entomology.

Perhaps, after the examination of the heads of lepidoptera and diptera, the most prominent feature that challenges observation is in the eyes. These do not have hexagonal facets as usually described for insects, but there is a simple aggregation of quite strongly convex circular lenses, each quite distinct from all the others, externally, and each undoubtedly capable of receiving a complete image in itself. The very strong convexity of the lens makes it very probable that the insects are excessively short sighted. When the head has been macerated in potash, the framework of the eye appears as though the setting for the lenses had been punched out with a round punch. I take this to be a much more simple eye formation than that of the *tabanidae* for instance.

The antennal structure derives its interest from the imbricated or scale like markings of the surface, sometimes confined to the terminal joints only, sometimes present on all, and from the system of sensory pits or pores.

In reference to this last I have found it invariable on all the specimens of the

same species, and this ought to furnish a most important character in the separation of species. The system is alike in no two species hitherto examined by me, though this may not hold good throughout the family.

Another very important point struck me. In none of the wingless forms does the poriferous system attain the complexity found in the winged forms. From the young louse just born, to the pupa, the poriferous system remains the same, and is very similar in all the species; but when the winged form is assumed, the specific poriferous system makes its appearance. It is well to say here, that I have not examined the true sexes and can say nothing of any species in the sexually perfect condition. In all the wingless viviparous females examined, the larval poriferous system was retained, and *I conclude therefore that we have to do, really, with a true reproduction among larval forms, and that wingless viviparous females among aphididae are not mature insects in any sense of the term; but that they represent simply an arrested larval stage, which under other conditions would develop into a winged form.* The winged viviparous females are ultimate or mature forms in which both sexual elements are represented in the form of the original germ cell, which by budding, develops the embryo brought forth. It seems rather elementary, but equally necessary to explain, that the term "budding" as used in reference to this method of reproduction, is a budding of the germ cell, and not a budding from the body of the insect; but in this latter sense I find that the term is quite generally understood.

With these, preliminary, observations and conclusions, I will proceed to details.

In all the aphides examined the first or basal joint is subglobose, stout and short; the second is also short, but scarcely globose; the third is the first of the long joints and it is longer than either the 4th or 5th, which are subequal in length, and sometimes is as long as both together. The sixth, or terminal, is what I have termed the whip joint. It enlarges gradually from the base for a short distance and is then rather abruptly narrowed from one side, giving a false appearance of segmentation. From this point it continues to the tip, gradually tapering to a point. It is flexible, and the resemblance to a whip is not fanciful.

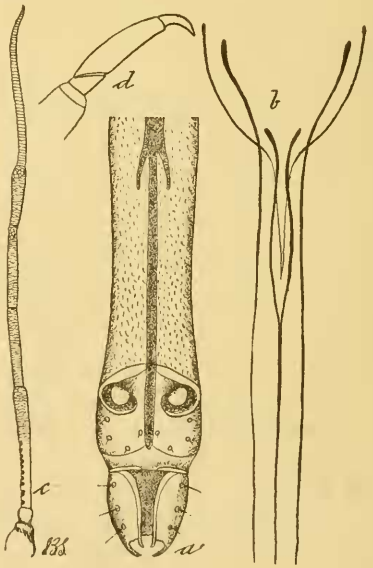

FIG. 1.

In the Wheat louse, *Siphonophora avenae* Fabr., the third joint is visibly imbricated only beyond the middle while all the following joints are obviously imbricated. The sensory pits are confined to a single row of eleven, extending from the base to beyond the middle of the joint. The 4th joint has no sensory pits and the 5th has a small group near its tip, only. The 6th joint has at the point of greatest dilation, and just before the sudden narrowing, a very distinct group of pits, and these are permanent in all stages, and very similar in all species. The absence of these would be a matter of very high systematic value.

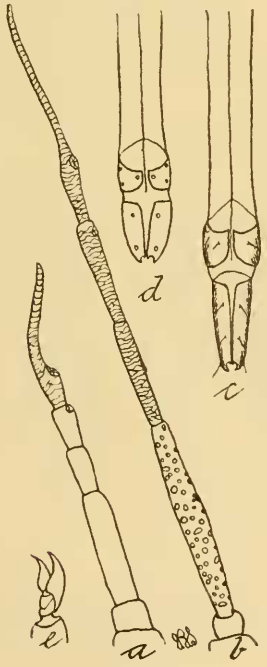

Fig. 2.

In the Cabbage louse, *Aphis brassicae* Linn., the poriferous system is entirely different. The 3rd joint is not, or but faintly imbricated, while the small, sensory pits are scattered all over the surface in no regular series and too numerous to count. In a case like this I should expect a considerable range of variation in the number of pits. The 4th joint is imbricated, as are all the following, but has no sensory pits. The 5th joint is very like that of *S. avenae*, as is also the 6th. In the immature forms the 5th joint is furnished with a single large pit at tip, and the usual small aggregation on joint 6.

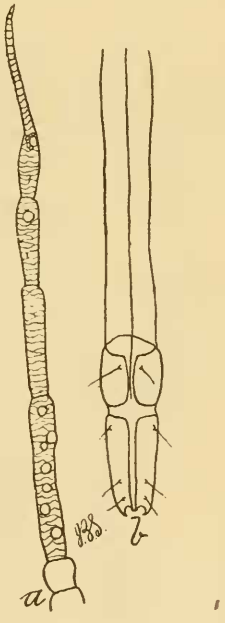

Fig. 3.

Aphis cucumeris Forbes, the Melon louse shows a somewhat different type

of structure. All except the basal small joints are distinctly imbricated, and the sensory pits are very much larger than in either of the preceding species. In this species the structure of the pits becomes more evident, but will not be further referred to here, as the Peach aphis affords a more satisfactory subject. The 3rd joint in this species has seven or eight rather irregularly placed pits, extending the full length of the joint. Joint 4 is free while 5 has a single large pit near the tip. Joint 6 has the usual little aggregation, one large pit, margined by several small ones.

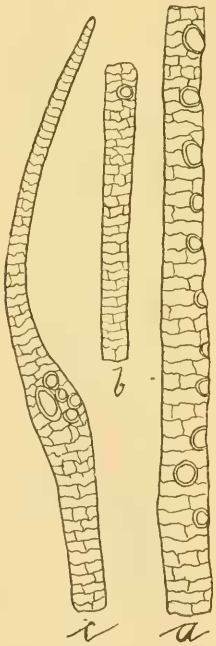

Fig. 4.

In the Cherry aphis, *Myzus cerasi* Fabr., the pores or pits are still larger, and the structure of the pits is still better brought out. On the 3rd joint, which with all subsequent ones is imbricated, there is a series of eleven very large pits in a single line: the fourth joint is free of such pits: the 5th joint has a single large pit near the tip, and the sixth joint as usual has a small group, consisting here of a very large oval pit with four smaller ones grouped at one side.

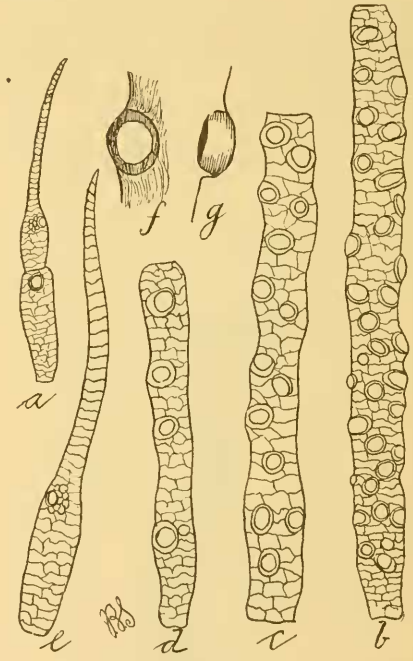

Fig. 5.

Most interesting of all, is the Peach aphid, *Aphis persicae-niger* E. F. Smith. In this species the poriforous

or sensory system attains its most complete development, so far as my observations extend. Every joint, except the small basal knobs, is imbricated, and each is furnished with sensory pits or pores. The third joint is irregular and knobby from the projecting margins of the pits, which are numerous and very large. The figure shows the appearance well, but it must be said that the enlargement of *b*, is only $\frac{2}{3}$ that of *a*, *c*, *d*, and *e*, so that it is really equal to the two following joints in length. Joint four has also a large number of pits, irregularly scattered on all sides, and this is the more remarkable since in none of the other species is it pitted at all. Joint five has four large and two small pits on one side—other not examined—, more also than in the other species. On joint six, on the contrary, the aggregation of pits is smaller than in the Cherry aphid, though the number of small pits is greater. Curiously enough, nothing in the larval antennae indicates this extreme development in the mature form. *All* of the wingless forms have this simple, single pit near the tip of 5, and the usual small group on 6. It has been already indicated that in this species the structure is best made out. This is due to the fact that every part is more thoroughly chitinized than in any other species save *M. cerasi*, and the action of potash and carbolic acid is not so destructive, while the parts are sufficiently cleared for study. We see here that we do not have simple pits to deal with; but rather special sense organs, apparently not directly communicating with the outer air, for on careful examination a fine, tense membrane is seen to close the opening, not from edge to edge, but as if drawn over a projecting rim. It is on a side view that we best get an idea of the structure which is fairly well shown at *f* and *g*. What are the functions of these pits? Not tactile, surely! Olfactory? Why should that require any tense membrane? Auditory? Here the membrane might serve as a drum to catch the vibrations; but why should there be such a difference in number? Why also do the darker, more chitinized forms have these pits relatively so much larger? These questions are easily asked; but I shall not try to answer them.

Besides the antennae I also studied the mouth parts of these insects and find that there is some small difference in the structure here, shown in the figures given; but scarcely worthy of note, except in the case of the wheat louse. In this species the beak is perhaps shorter and broader than in the others, while the ante-apical segment has on each side a peculiar flap, gouged from the body of the joint and covering loosely the pit thus caused. This is found in all stages of this species, and nothing like it has been found in any other examined by me.

Within this beak are the four bristles, two of them connate except at base, which are supposed to represent the maxillae and mandibles, the beak itself being a modified labium. I wish to decidedly state my disbelief in any such

homology. It is utterly unphilosphocal to accept without the clearest proof such a structural modification as this change in position of the mandibles would require, and the modification of the ordinary labium into a beak of this character is a process that ought to be proven. It seems to be assumed that the "labium" of the hemiptera is the same as the "labium" of the diptera, e. g. *Culex*, and if this is so, I have a paper now in press, in which I claim to prove that this "labium" in the diptera is really only a modified galea, or a maxillary structure. I hope to prove some time in the future, when I can get the necessary material, how this modification of the hemipterous mouth came about, and that the mandibles do not, habitually, become internal mouth structures so long as there are other organs enough more naturally situated.

EXPLANATION TO BASE FIGURES.

Fig. 1. *Siphonophora avenae*. *a*, beak; *b*, bristles of mouth—"mandibles" and "maxillae;" *c*, antenna of winged viviparous female.

Fig. 2. *Aphis brassicae*. *a*, antenna of wingless forms; *b*, antenna of winged viviparous female; *c*, beak of young lice; *d*, beak of mature, winged form.

Fig. 3. *Aphis cucumeris*. *a*, antenna of winged viviparous female; *b*, beak of wingless forms.

Fig. 4. *Myzus cerasi*. *a*, 3rd; *b*. 5th; *c*, 6th joint of antenna of winged viviparous female.

Fig. 5. *Aphis persicae-niger*. *a*, antenna of immature forms, joints 5 and 6; *b*, 3rd; *c*, 4th; *d*, 5th; *e*, 6th joint of antenna of winged viviparous female; *f*, sensory pit from front; *g*, same from side.

NOTES ON TWO SPECIES OF DATANA WITH DESCRIPTIONS OF THEIR LARVAL STAGES.

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Of all the closely related species of this genus, the two which approach each other the most nearly and are most difficult to distinguish in the imago state, are *D. major* and *D. drexelii*. I have elsewhere called attention to the main feature by which they are to be distinguished, which, after all, is only a matter of degree of coloration. The species differ, or rather tend to differ, in other points beside the brightness of the costal shade, namely, in the more entire outer margin of the primaries, and the darker more even coloration of the wings of *D. major*.

The size is the same in both species, there are no markedly distinctive male genital characters, and the lines and